INDOOR AIR POLLUTION AND WOMAN LUNG CANCER

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The death rate (per 100,000) of woman lung cancer has increased from 17.8 (1976) to 24.7 (1985) in Guangzhou. The woman smoking rate is only 3.9 %, but over 80 % of woman who died from lung cancer had done domestic cooking frequently during their lifetime. The concentrations of air pollutants (SO_2 , NOx, total suspended particulates, sedimentary dust, B(a)P, radon, thoron and their daughters) indoor was higher than outdoor, and they main source come from domestic cooking in downtown. Besides, the levels of woman urine-B(a)P cooking used coal were higher than those cooking used gas. It suggests that coal burning for cooking might be a cause for inducing woman lung cancer.

INTRODUCTION

Lung cancer is one of the major health problems worldwide. Over the past three decades the death rate from lung cancer has increased rapidly in both the developed and developing countries. Especially noteworthy is the marked increase of woman lung cancer.

Although the cause of lung cancer is better understood than other malignant neoplasms, reports from different studies are quite variable. Andrews (1985) reported that smoking is a major causal factor of lung cancer in woman in the United States. Ayiomamitis (1985) also points out that recent trends towards increased use of tobacco products may account for the drastic increase in female rate in Canada. However, the percentage of smokers among woman with lung cancer in Italy was shown to be only 29 % (Samartino, 1985). Svensson (1985) suggests that indoor exposure to Radon and Radon daughters from ground emissions may be related to bronchial cancer among women in Stockholm and smoking habits did not appear to be a major confounding factor for this disease. The incidence rate of lung cancer among women in Xianwei,a county of China, is very high and they do not smoke at all (Zhao, 1985).

For the purposes of further identifying the lung cancer associated factors, Guangzhou lung cancer deaths occurring between

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1980 and 1985 were reviewed. This motality data was analyzed along with data on indoor and outdoor air pollution.

MATERIALS AND METHODS

Accurate reports on the number of death from malignant neoplasms were obtained from the city cremation station, over 95 % of deceased Guangzhou residents are cremated, and from local police stations where relatives must cancel the deceased's name from police records and report the cause of death. Health bureau personnel interview relatives using a uniform questionnaire which is then completed by reviewing hospital clinic records.

Indoor air quality was investigated in 20 homes located in downtown Guangzhou. The measured pollutants included SO_2 , NOx, TSP and B(a)P. Samples of SO_2 and NOx were collected at 2-hour intervals from 7:00 am to 7:00 pm for five consecutive days each season. TSP and B(a)P were measured once a day on the same five days each season. Outdoor air quality data were obtained from the Global Atmospheric Monitoring Station of the World Health Organization (WHO), which was founded in 1980 in Guangzhou city.

The level of radioactivity of indoor and outdoor were investigated in 40 homes twice a year in summer and winter, the indoor data was analyzed along not only with construction materials but also with cooking fuels.

Indoor air pollution comes mailly from domestic cooking in Guangzhou. For further study the relationship between the kitchen air pollutants and their effects on body, the level of TSP, TSP-B(a)P, SD, SD-B(a)P in 72 homes and the concentrations of urine-B(a)P in 44 woman homemakers, living at the corresponding homes and never smoking, have been investigated.

A case control study was carried on 662 lung cancer deaths, this number was about 82% of total lung cancer deaths in 1985, and 662 non-lung cancer deaths. Matched for sex (M 446, F 216) age (± 2 year) and living places. The relative risks (odds ratios) for smoking and for coal fumes exposure were analyzed.

RESULTS & DISCUSSION

Mortality data for 3,305 cases of lung cancer (M 2,178, F 1,079) were collected between 1980 and 1985. It is estimated that over 95 % of all deaths due to lung cancer during that period in downtown Guangzhou were recorded.

Total and percentages by cigarettes per day of male and female with lung cancer are shown in Table 1. The percentage of non-smoking lung cancer cases among males is only 6.7 %, but among females it is as hgh as 41.4%,and 54% of them did not smoke themselves also had no exposure to other smokers during their lives.

Table

Cigarettes per day
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10-
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Ratios(SMR) by Job
shown in Table 2.
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Table 2 DEATH RATE A

Occupation
Homemaker
Chemist
Machine repairman
Cargo handler
Cook
Construction worke
Salesclerk
Office worker
Teacher
Engineer
Doctor
Waiter/waitress
Total

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Table 1. SMOKING HISTORY IN 3,305 LUNG CANCER DEATHS IN GUANGZHOU, CHINA (1980-1985)

Cigarettes per day	Male		Female	
	No.	%	No.	%
1-	77	3.54	92	8.53
10-	365	16.76	206	19.09
20-	927	42.56	223	20.67
30-	348	15.98	67	6.21
40+	314	14.42	44	4.08
No smoking	147	6.74	447	41.42
Total	2,178		1,079	

In 1982 there were 601 cases who died from lung cancer in Guangzhou, this mortality data was analyzed along with data on 1982 Guangzhou census. The death rate and Standard Mortality Ratios(SMR) by job (above 10 years) of lung cancer deaths are shown in Table 2. In general, the incidence of lung cancer among blue-collar workers is higher than for those with white-collar Job, however the highest job SMR in females is homemaker.

Table 2 DEATH RATE AND SMR BY JOB OF LUNG CANCER DEATHS IN GUANGZHOU, CHINA (1982)

Occupation	Death rates (per 100,000)		S M R	
	M	F	M	F
Homemaker	112.3	112.1	328	1078 *
Chemist	146.4	73.4	880 *	842 *
Machine repairman	103.4	13.3	769 *	294
Cargo handler	127.4	93.0	490 *	1051 *
Cook	186.3	40.0	588 *	335 *
Construction worker	131.5	0.0	491 *	0
Salesclerk	121.0	39.5	300	360 *
Office worker	84.5	46.1	155 *	266 *
Teacher	34.2	44.5	73	352 *
Engineer	38.9	10.1	100	120
Doctor	25.7	5.1	66	47
Waiter/waitress	25.7	10.9	45	23
Total	92.4	49.1		

* : P< 0.01

For comparison, Table 3 shown both indoor and outdoor levels of SO_2, NOx, TSP and B(a)P for 1984. Atmospheric sampling stations are near the houses where the indoor air quality was monitored. The results demonstrate that indoor air pollution is more severe than outdoor pollution, especially in B(a)P levels. Table 4 shown the comparison of radioactivity level between indoor and outdoor, the concentration of radon, thoron and their daughters indoor also higher than outdoor, especially in thoron, but all of them

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are under the China Basic Standards for Radiological Protection (GB 479-84). (radioactivity data from Wu Zenghan)

Table 3. COMPARISON OF AVERAGE LEVELS OF SO_2 , NOx, TSP AND B(a)P BETWEEN INDOOR AND OUTDOOR IN GUANGZHOU (1984)

	SO_2 ($\mu g/M^3$)	NOx($\mu g/M^3$)	TSP($\mu g/M^3$)	B(a)P($\mu g/100M^3$)
Indoor	190±80	70±30	210±70	1.30±0.98
Outdoor	80±20	40±10	200±30	0.50±0.26

Table 4. COMPARISON OF CONCENTRATIONS OF RADON, THORON AND THEIR DAUGHTERS BETWEEN INDOOR AND OUTDOOR IN GUANGZHOU

	Radon (Bq/M^3)	Radon daughter (10^{-6} J/M^3)	Thoron (Bq/M^3)	Thoron daughter (10^{-6} J/M^3)
Indoor	17.8±2.1	5.84±0.72	37.0±7.2	6.94±1.06
Outdoor	13.3±2.1	4.86±0.33	14.5±2.6	4.72±0.62
GB 4792-84	3300.0	19.0	75.0	57.0

Table 5 shown the indoor radioactivity levels in different constructive materials and different cooking fuels. The results demonstrated that green brick wall higher than red brick, brick floor higher than cement floor, and coal burning higher than gas burning.

Table 5. THE INDOOR RADIOACTIVITY LEVELS IN DIFFERENT CONSTRUCTION MATERIALS AND DIFFERENT COOKING FUELS

	No.	Radon(Bq/M^3)	Thoron(Bq/M^3)	P-value
Green brick	13	17.6±4.4	42.9±15.3	
Red brick	64	17.6±4.8	35.9±19.3	
Brich floor	37	18.5±4.0	43.5±16.1	P <0.01
Cement floor	21	17.6±4.8	29.3±14.2	
Coal burning	49	18.6±4.1	42.5±19.4	P <0.01
Gas burning	31	16.6±5.1	28.3±13.1	

Seasonal trends of daytime indoor SO_2 and NOx measurements for the 20 homes surveyed are shown in Fig. 1. There are three peaks of concentration of SO_2 and NOx at 7, and 11 am and at 7 pm. The winter curves are higher than for the other seasons. It is suggest that the main source of this pollution was come from domestic cooking.

A comparison of the kitchen air pollution and woman urine-B(a)P between briquette coal and liquefied petroleum gas burning kitchen are shown in Table 6. Since 1960 briquette coal is commonly used by Guangzhou residents in stoves without chimney. It

Table 6 COMPARIS
URINE-B(a)P BI

Total suspended Partic
TSP-B(a)P($\mu g/100M^3$)
Sedimentary dust(gm/M^2
SD-B(a)P($\mu g/M^2$ /Month
Urine-B(a)P(ng/l)

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Table 6 COMPARISON OF THE CONCENTRATIONS OF TSP, TSP-B(a)P SD,SD-B(a)P AND URINE-B(a)P BETWEEN THE COAL BURNING KITCHEN AND GAS BURNING KITCHEN

	Briquette coal burning kitchen		Liquefied Petroleum gas burning kitchen		P-value
	No.	X±SD	No.	X±SD	
Total suspended Particulates(μg/M³)	37	322±131.0	27	188±6.70	P <0.01
TSP-B(a)P(μg/100M³)	21	11.9±9.3	21	2.2±1.8	P <0.01
Sedimentary dust(gm/M² /Month)	37	11.9±8.4	24	5.4±2.9	P <0.01
SD-B(a)P(μg/M² /Month)	28	11.1±8.4	12	2.2±1.7	P <0.01
Urine-B(a)P(ng/l)	24	4.0±1.8	20	2.8±1.5	P <0.05

caused severe indoor air pollution not only, but also resulting homemakers urine-B(a)P increased.

The results of case control study are shown in Table 7. Both the Mantel-Haenszel test and the stratification analysis unanimously indicate that smoking for male and coal fumes exposure for female were the risk factors for inducing human lung cancer.

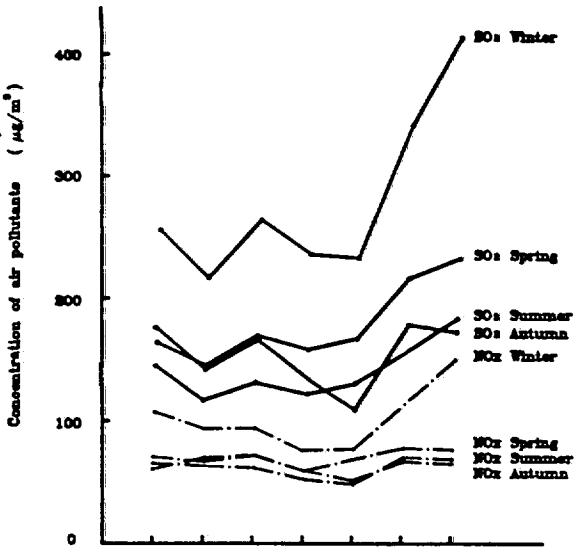

Fig.1 INDOOR SO_2 AND NOx DURING THE DAYTIMES IN FOUR SEASONS FOR TWENTY FAMILIES IN GUANGZHOU, CHINA (1984-1985)

Lung cancer death rate has increased rapidly in worldwide suggesting there are some new exogenous factors related to lung cancer have been introduced into human environment, and this factors might be existence in whole world. Smoking, occupational exposure and atmospheric pollution including radioactivity pollution have been reported as the relative factors, however, in some countries high incidence of lung cancer and low smoking rate can be occurred. Occupational exposure can only be used to explain the incidence increase in the special population, e.g. chromate workers,but not to explain lung cancer among the general population in an urban area. A stable exogenous factor, such as the background of radioactivity, does not adequately explain the phenomenon of increasing lung cancer rate over a short time. Atmospheric

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Table 7 RELATIVE RISKS (ODDS RATIOS) FOR SMOKING AND COAL FUMES EXPOSURE AMONG LUNG CANCER DEATHS (1985)

	Male		Female	
	O R	P-Value	O R	P-Value
Smoking	3.8	<0.01	1.90	<0.05
Coal fumes exposure	0.99		14.52	<0.001
Smok+non-smok+coal exp.+non-coal exp.	1.00		1.00	
Non-smok+non-coal exp.	0.31		0.31	
Smoking+non-coal exp.	4.40	<0.01	0.60	
Non-smoking+coal exp.	1.40		3.10	<0.05
Smoking+coal exp.	4.20	<0.01	5.80	<0.01

pollution accompanying industrialization might be the important factors for lung cancer, however the relationship between indoor air quality and health is, after all, closer and more direct than that between outdoor air quality and health.

If the indoor air pollution was the major relative etiologic factors for inducing woman lung cancer as demonstraled in our study, there are some phenomena still difficult to explain, for example, why did the incidence of woman lung cancer increased rapidly in recent years,and why the major cell type of woman lung cancer is adenocarcinoma and not epidermoid carcinoma, in general, the cell type induced by carcinogen B(a)P is mainly epidermoid carcinoma.

CONCLUSIONS & RECOMMENDATIONS

In Guangzhou, indoor air pollution was higher than outdoor, the main source was coal burning for domestic cooking, coal burning caused severe indoor air pollution not only, but also resulting homemakers urine-B(a)P increased. The OR of coal fumes exposure for woman was as high as 14.5. However, this possible cause proposed by epidemiologic study need further identifying by laboratory research.

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RISK ASSESSMENT IN THE SE
OF PRIORITIES ON CONTROL
IN THE PREVENTION OF CHRO
RESPIRATORY DISEASES

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